

the work involved in the systematic adoption of the anatomical method is so enormous, that it seems hardly likely that great progress will be made in this direction for some time to come.

The value of chemical substances in the plant is also emphasised for helping to establish points of affinity, though cases do occur in which similar substances of a peculiar nature are found in quite unrelated plants. One of the difficulties of the method lies in making the choice of those anatomical characters which may prove to be of systematic importance. It is clear that characters, which are ancestral rather than adaptive, will be of most value from the taxonomic point of view. The value of an anatomical character, however, cannot be predicted, and at times exceptions will be found to a character which appears to be otherwise typical of the particular group or order. Much light may be expected to be thrown by the anatomical method as to whether certain features in a plant are to be regarded as ancestral or adaptive from a comparison with other closely allied plants; and it may be noted in passing that careful work in this direction is being done on the anatomy of seedlings in this country. A word of warning, however, is necessary, which is not forgotten by the author, to those adopting the method, since it is not yet known whether a given character may be constant in a single species under different conditions of cultivation. The tea-plant, for instance, may or may not possess spicular cells in the leaf.

Dr. Solereder concludes his excellent and interesting introduction with a summing up of the possibilities of and warnings against the dangers of the anatomical method. It only remains to praise most highly the way in which Messrs. Boodle and Fritsch, under the careful editorship of Dr. Scott, have carried out the very arduous work of translating a volume, every page of which seems scarcely large enough to contain the solid and pregnant matter with which it is crowded.

A word of thanks must be added to Dr. Fritsch for the glossary at the end of the second volume, in which the chief terms used in anatomical description are defined, or a reference to a definite passage in the work is given where such terms are explained. In most cases the German equivalents of the terms are given, making the glossary of considerable value.

A. W. H.

PROBLEMS OF THE PAPER MILL.

Chapters on Paper-making. Vol. v., Concerning the Theory and Practice of Beating. By Clayton Beadle. Pp. vii+182. (London: Crosby Lockwood and Son, 1908.)

THIS is a record of observations incidental to an analytical study of the process of "beating" in the paper mills, the process by which the fibrous raw materials are prepared, by wet milling, for the actual paper-making operations. The central importance of the beating process is generally recognised; it is also evident that it is a highly complex operation. The purpose of this volume is to suggest to paper-makers

what are the factors of the result, and how they may be effectually studied by way of observations which can be recorded in terms of numbers.

The author's observations are in the main those of mechanical energy consumed in the various stages of beating, *i.e.* in the "breaking in," the "beating" proper, and in "refining."

Beaters of the various types have been analytically studied, and the results are discussed in reference to the general structural details of the machines themselves, as well as of the main working parts, that is, the roll and the bed-plate. The main purpose is to establish their relative economy and efficiency. Thus the Hollander is generally contrasted with the more modern types of beaters, *e.g.* the "Reed," the "Taylor," and the "Tait engine," and the separated operations of "refining" in such engines as the "Kingsland" or "Jordan." Chapter x., on "the relative merits of stone and metal beater bars," is a useful contribution to progressive problems.

The author generally avoids drawing positive conclusions in view of the fact that efficiency, or the integral result of the preparation, involves those still obscure factors of condition, that is, the relation determined between the beaten fibres and the watery medium in which they are carried in suspension, to be compacted into the wet web on the wire of the paper machine or mould. This is the subject-matter of a special chapter (chapter xvii.), which records the results of experiments in the grading or fractionation of pulps by dry or wet methods, the former giving results according to dimensions, the latter introducing the complicating factor of "hydration" or "wetness."

The book is certainly a record of progress in the technology of paper-making. It emphasises the criticism which paper-makers make on the realistic tendencies of our technical schools. A "model" paper-making plant, such as has been installed at the Manchester School of Technology, is so far illusive in its realism that a "model beater" is not a representation to scale of the working conditions of the ordinary engine; and as the beating process constitutes the essential preparation of pulps, the educational result of a model mill is weakened by the implication of an incorrect perspective.

Contrariwise, the author's observations suggest an individuality or idiosyncrasy of beating engines, and this degree of unconformity to type entails special study of each machine in work, which study may be purely empirical or may be based upon selective quantitative investigations of the essential factors.

The technical records of this book are intended to serve as models of such investigations in the mill.

The educational value of this volume is weakened by its method or want of method. The author trusts his matter to evolve its own logical form and cohesion, wherein he so far abdicates the privileged position of teacher, which is to be didactic even when some risks have to be taken in stating conclusions; this is necessary to awaken and sustain the interest of the student.

The matter would be much improved by a clear *exposé* of principles, and the contributory factors of

aggregate effects, the experimental results being used to illustrate and develop the argument.

These criticisms do not depreciate the value of the volume as a record of serious, useful experimental inquiry. It is expressly to be commended to managers and workers in the mill, who will find in it much to stimulate observation and investigation with immediately productive results.

THE WORKS OF LINNÆUS.

Linnæus. Door Dr. J. Valckenier Suringar. Pp. 106. (s'Gravenhage: Martinus Nijhoff, 1908.)

THE scope of this volume may best be given by a summary of the introduction. The author says that though much has been written about Linnæus, yet he is but imperfectly known, which is probably due to the fact that the various accounts and addresses only supply a very superficial picture of the man. His sexual system and binomial nomenclature are the warp and woof of his work, and many who are content to regard Linnæus as a great man are ready to ask if these two achievements are anything but of the common. With the exception of a few volumes of systematic descriptions, Linnæus's books are no longer read, for who in these days of rapid work can find sufficient time to read his Latin octavos?

With a view to remedy this state of things, the author proceeded to study the works of Linnæus, and the farther he went the more his wonder grew. From the very first, Linnæus was evidently a giant amongst his contemporaries, and from him a stream of science has flowed and has overpassed its boundaries, leading with titanic force into new paths. Linnæus's work may be taken as an example for all time of methodic application and achievement. The year of the festival (1907, when the preface was written) may be taken as a fitting opportunity to set out the result of the inquiries in honour of Linnæus.

Very little will be found in this volume of biographic detail which may readily be found elsewhere. The author's aim has been to display the man and his ideals, so far as practicable, in his own words. In addition to this, the contemporaries and correspondents of Linnæus have been drawn upon, especially two men of renowned personality, Dillenius and Haller, the latter at once friend and opponent, and so giving a truer notion than by any other means.

The author has thus produced a work which in many respects stands alone. Deliberately refusing to supply biographic details or speculations, it differs markedly from the admirable volumes of Prof. Fries and the unfinished fragment of the late Prof. Oscar Levertin. Dr. Suringar follows Linnæus in his publications from early years to maturity. He has scrutinised the text and any published letters which bear upon them, and has thus succeeded in setting before us the man and his aims, his astonishing powers of work, his poetic imagination, his magnetic attraction, his artless vanity, his real modesty—the modesty of a great worker who has higher aims than those

attained. Full references are given to the illustrative passages, both in original and in translation.

Dr. Suringar dwells at some length upon four ideas promulgated by Linnæus in his "*Systema Naturæ*" and the "*Genera Plantarum*" which soon followed it. These four are:—(1) A clear generic idea, (2) natural description of genera, (3) the sexual system, and (4) generic nomenclature. In each one of these, Linnæus so immensely improved upon the notions of his predecessors that his improvements became predominant almost of necessity. Each of these is separately considered and their relative merits weighed.

We must confess that we should have been grateful if the author could have thrown more light upon the life of Linnæus during those three busy years he spent in the Netherlands. The record is marvellous, even bearing in mind that Linnæus brought several manuscripts with him, but the cares of proof-reading must have been great. Clifford, though liberal, was keen upon securing full value for his outlay, and the splendid "*Hortus Cliffortianus*" was entirely composed and printed whilst Linnæus was under Clifford's roof. He confessed in a letter that he was too busy to eat, and still more so to sleep. Small wonder that three such strenuous years should have broken down the strong constitution of the young Swede, and made his longing for home irresistible. Possibly his life was too devoted to natural history to have any noteworthy events.

No one can read the volume without gaining a better idea of the strong personality and genius of the Småland curate's son, who, by his genius and powers of work, transformed the whole conception of biology, and established it on a basis and with a nomenclature which permitted of its development according to modern needs. Everybody who was present last year at the Linnean celebrations in Sweden must have been struck by the deep hold Linnæus has upon the hearts of his fellow-countrymen. Dr. Suringar has brought together passages from various sources which go very far to justify the pride of the Swedes in their great naturalist.

B. D. J.

PRACTICAL PHYSICS.

A Manual of Practical Physics for Students of Science and Engineering. Vol. i., Fundamental Measurements of the Properties of Matter and Heat. By E. S. Ferry and A. T. Jones. Pp. xi+273. (London: Longmans, Green and Co., 1908.)

THIS volume is a very sound introduction to the practical measurement of the properties of matter and the more important properties of heat. The book is strictly practical, no attempt being made to discuss theories; sufficient explanation is, however, usually given for a clear and intelligent appreciation of the succeeding experiment.

The book commences with a consideration of the value of errors, the principles of which are not afterwards given due importance. The section then ends with a somewhat elementary introduction to the